Program Outcomes, Program Specific Outcomes, Course specific Outcomes

Department of Chemistry

Program Outcome: B.Sc. (Chemistry)	
After successful completion of three-year degree program in Chemistry, a student should be able to;	
➢	Every branch of Science and Technology is related to Chemistry
➢	Helps in understanding the causes of environmental pollution and can open up new methods for environmental pollution control.
➢	Demonstrate, solve and an understanding of major concepts in all Disciplines of chemistry.
➢	Solve the problem and also think methodically, independently and draw a logical conclusion.
➢	Employ critical thinking and the scientific knowledge to design, carry Out, record and analyze the results of chemical reactions.
➢	Create an awareness of the impact of chemistry on the environment, Society and development outside the scientific community.
➢	To inculcate the scientific temperament in the students and outside The scientific community.
➢	Use modern techniques, decent equipments and Chemistry software's
➢	Find out the green route for chemical reaction for sustainable Development.

Program Specific Outcome: B.Sc.	
➢	Gain the knowledge of Chemistry through theory and practicals.
➢	To explain nomenclature, stereochemistry, structures, reactivity, And mechanism of the chemical reactions.
➢	Identify chemical formulae and solve numerical problems.
➢	Use modern chemical tools, Models, Chem.-draw, Charts and Equipments.
➢	Know structure-activity relationship.
➢	Understand good laboratory practices and safety.
➢	Develop research-oriented skills.
➢	make aware and handle the sophisticated instruments/equipments

Course Outcomes of B.Sc. (Chemistry)

Class	Course title & Code	Course Outcome
F.Y.B.Sc.	**CH-101: Physical Chemistry**	• Students will be able to apply thermodynamic principles to physical and chemical process • Calculations of enthalpy, Bond energy, Bond dissociation energy, resonance energy • Variation of enthalpy with temperature –Kirchoff's equation • Third law of thermodynamic and its applications Ionic equilibria chapter will led students to understand • Concept to ionization process occurred in acids, bases and pH scale • Related concepts such as Common ion effect hydrolysis constant, ionic product, solubility product • Degree of hydrolysis and pH for different salts, buffer solutions Knowledge of Chemical equilibrium will make students to understand • Relation between Free energy and equilibrium and factors affecting on equilibrium constant. • Exergonic and endergonic reaction • Gas equilibrium, equilibrium constant and molecular

		interpretation of equilibrium constant
F.Y.B.Sc.	**CH-102: Organic Chemistry**	• The students are expected to understand the fundamentals, principles, and recent developments in the subject area. • It is expected to inspire and boost interest of the students towards chemistry as the main subject. • To familiarize with current and recent developments in Chemistry. • To create foundation for research and development in Chemistry.
F.Y.B.Sc.	**CH-103: Chemistry Practical Course I**	• Importance of chemical safety and Lab safety while performing experiments in laboratory • Determination of thermochemical parameters and related concepts • Techniques of pH measurements • Preparation of buffer solutions • Elemental analysis of organic compounds (non instrumental) • Chromatographic Techniques for separation of constituents of mixtures
F.Y.B.Sc.	**CH-201: Inorganic Chemistry**	• Various theories and principles applied to revel atomic structure • Origin of quantum mechanics and its need to understand structure of hydrogen atom • Schrodinger equation for hydrogen atom • Radial and angular part of hydrogenic wave functions • Significance of quantum numbers • Shapes of orbitals • Explain rules for filling electrons in various orbitals- Aufbau's principle, Pauli exclusion principle, • Hund's rule of maximum multiplicity • Discuss electronic configuration of an atom and anomalous electronic configurations. • Describe stability of half-filled and completely filled orbitals. • Discuss concept of exchange energy and relative energies of atomic orbitals • Design Skeleton of long form of periodic table. • Describe Block, group, modern periodic law and

		periodicity. • Classification of elements as main group, transition and inner transition elements • Write name, symbol, electronic configuration, trends and properties. • Explain periodicity in the following properties in details: • Effective nuclear charge, shielding or screening effect; some numerical problems. • Atomic and ionic size. • Crystal and covalent radii • Ionization energies • Electronegativity- definition, trend, Pauling electronegativity scale. • Attainment of stable electronic configurations. • Define various types of chemical bonds- Ionic, covalent, coordinate and metallic bond • Explain characteristics of ionic bond, types of ions, energy consideration in ionic bonding, lattice and solvation energy and their importance in the context of stability and solubility of ionic compounds • Summarize Born-Lande equation and Born-Haber cycle, • 5. Define Fajan's rule, bond moment, dipole moment and percent ionic character.
F.Y.B.Sc.	**CH- 202: Analytical Chemistry**	By studying this course students are able to understand • Analytical Chemistry –branch of chemistry • Perspectives of analytical Chemistry • analytical problems • Calculations of mole, molar concentrations and various units of concentrations which will be helpful for preparation of solution • Relation between molecular formula and empirical formula • Stoichiometric calculation • Define term mole, millimole, molar concentration, molar equilibrium concentration and Percent Concentration. • SI units, distinction between mass and weight • Units such as parts per million, parts per billion, parts per thousand, solution-dilatant volume ratio, • function density and specific gravity of solutions. • Separation of binary mixtures and analysis • Elemental analysis -Detection of nitrogen, sulfur, halogen and phosphorous by Lassiagen's test. • Purification techniques for organic compounds. • pH meter and electrodes for pH measurement • Measurement of pH

		• Working of pH meter • iv. Applications of pH meter
F.Y.B.Sc.	**CH- 203: Chemistry Practical –II**	By studying this course students are able to understand • Inorganic Estimations using volumetric analysis • Synthesis of Inorganic compounds • Analysis of commercial products • Purification of organic compounds • Preparations and mechanism of reactions involved
S.Y.B.Sc.	**CH-301: Physical and Analytical Chemistry**	After studying this course students are able to understand • Define, explain and compare meaning of accuracy and precision. • Apply the methods of expressing the errors in analysis from results. • Explain / discuss different terms related to errors in quantitative analysis. • Apply statistical methods to express his / her analytical results in laboratory. • Solve problems applying equations. • Explain / define different terms in volumetric analysis such as units of concentration, indicator, equivalence point, end point, standard solutions, primary and secondary standards, complexing agent, precipitating agent, oxidizing agent, reducing agent, redox indicators, acid base indicators, metallochome indicators, etc. • Perform calculations involved in volumetric analysis. • Explain why indicator show colour change and pH range of colour change. • To prepare standard solution and **b.** perform standardization of solutions. • To construct acid – base titration curves and performs choice of indicator for particular titration. • Explain / discuss acid-base titrations, complex metric titration / precipitation titration / redox titration. • Apply volumetric methods of analysis to real problem in analytical chemistry / industry • Discuss factors influencing adsorption, its characteristics, differentiates types as physisorption and Chemisorption

		• Classification of Adsorption Isotherms, to derive isotherms. • Explanation of adsorption results in the light of Langmuir adsorption isotherm, Freundlich's adsorption Isotherm and BET theory. • Apply adsorption process to real life problem. • Determination of order of reaction by integrated rate equation method, graphical method, half-life method and differential method. • Explain / discuss the term energy of activation with the help of energy diagram. • Explanation for temperature coefficient and effect of temperature on rate constant k. • Derivation of Arrhenius equation and evaluation of energy of activation graphically. • Derivations of collision theory and transition state theory of bimolecular reaction and comparison.
S.Y.B.Sc.	**CH-302: Inorganic and Organic Chemistry**	• Identify and draw the structures aromatic hydrocarbons from their names or from structure name can be assigned. • Explain / discuss synthesis of aromatic hydrocarbons • Give the mechanism of reactions involved. • Explain /Discuss important reactions of aromatic hydrocarbon. • To correlate reagent and reactions. • Identify and draw the structures alkyl / aryl halides from their names or from structure name can be assigned. • Write / discuss the mechanism of Nucleophilic Substitution (SN1, SN2 and SNi) reactions. • To correlate reagent and reactions. • Give synthesis of expected alkyl / aryl halides. • Identify and draw the structures alcohols / phenols from their names or from structure name can be assigned. • Able to differentiate between alcohols and phenols • Write / discuss the mechanism of various reactions involved. • Give synthesis of expected alcohols / phenols. •
S.Y.B.Sc.	**CH-303: Practical Chemistry-III**	• Verify theoretical principles experimentally. • Interpret the experimental data on the basis of theoretical principles.

		• Correlate theory to experiments. Understand/verify theoretical principles by experiment observations; explain practical output / data with the help of theory. • Understand systematic methods of identification of substance by chemical methods. • Write balanced equation for the chemical reactions performed in the laboratory. • Perform organic and inorganic synthesis and is able to follow the progress of the chemical reaction by suitable method (colour change, ppt. formation, TLC). • Set up the apparatus / prepare the solutions - properly for the designed experiments. • Perform the quantitative chemical analysis of substances explain principles behind it. • Systematic working skill in laboratory will be imparted in student.
S.Y.B.Sc.	**CH-401: Physical and Analytical Chemistry**	• Define different terms in conductometry such as electrolytic conductance, resistance, conductance, Ohm's law, cell constant, specific and equivalent conductance, molar conductance, Kohlrausch's law, etc. • Discuss / explain Kohlrausch's law and its Applications, Conductivity Cell, Conductivity Meter, Whetstone Bridge. • Explain / discuss conductometric titrations. • Apply conductometric methods of analysis to real problem in analytical laboratory. • Solve problems based on theory / equations. • Correlate different terms with each other and derive equations for their correlations • Discuss / explain / derive Beer's law of absorptivity • Explain construction and working of colorimeter. • Apply colorimetric methods of analysis to real problem in analytical laboratory. • Solve problems based on theory / equations. • Define different terms in column chromatography such as stationary phase, mobile phase, elution, adsorption, ion exchange resin, adsorbate, etc.

		• Explain properties of adsorbents, ion exchange resins, etc. • Discuss / explain separation of ionic substances using resins. • Discuss / explain separation of substances using silica gel / alumina. • Differentiate between ideal and non-ideal solutions and can apply Raoult's law. • Interpretation of i) vapour pressure–composition diagram ii) temperature- composition diagram. • Explain distillation of liquid solutions from temperature – composition diagram. • Explain / discuss azeotropes, Lever rule, Henrys law and its application. • Discuss / explain solubility of partially miscible liquids- systems with upper **c**ritical. Solution temperature, lower critical solution temperature and having both UCST and LCST.
S.Y.B.Sc.	**CH-402: Inorganic and Organic Chemistry**	Isomerism in coordination complexes Explain different types of isomerism in coordination complexes • Apply principles of VBT to explain bonding in coordination compound of different geometries. • Correlate no of unpaired electrons and orbitals used for bonding. • Identify / explain / discuss inner and outer orbital complexes. • Explain / discuss limitation of VBT • Explain principle of CFT. • Apply crystal field theory to different type of complexes (Td, Oh, Sq. Pl complexes) • Explain: i) strong field and weak field ligand approach in Oh complexes ii) Magnetic properties of coordination compounds on the basis of weak and strong ligand field ligand concept. iii) Origin of colour of coordination complex. • Calculate field stabilization energy and magnetic moment for various complexes. • To identify Td and Sq. Pl complexes on the basis of magnetic properties / unpaired electrons. • Explain spectrochemical series, tetragonal distortion / Jahn-Teller effect in Cu (II) Oh complexes only • Identify and draw the structures aldehydes and

		ketones from their names or from structure name can be assigned. • Explain / discuss synthesis of aldehydes and ketones. • Write / discuss the mechanism reactions aldehydes and ketones. • Explain /Discuss important reactions of aldehydes and ketones. • To correlate reagent and reactions of aldehydes and ketones • Give synthesis of expected aldehydes and ketones. • Perform inter conversion of functional groups • Identify and draw the structures carboxylic acids and their derivatives from their names or from structure name can be assigned. • Explain / discuss synthesis of carboxylic acids and their derivatives. • Write / discuss the mechanism reactions carboxylic acids and their derivatives. • Explain /Discuss important reactions of carboxylic acids and their derivatives. • Correlate reagent and reactions of carboxylic acids and their derivatives • Give synthesis of expected carboxylic acids and their derivatives. • Perform inter conversion of functional groups • Identify and draw the structures amines from their names or from structure name can be assigned. • Explain / discuss synthesis of carboxylic amines. • Write / discuss the mechanism reactions carboxylic amines. • Explain /Discuss important reactions of carboxylic amines. • To correlate reagent and reactions of carboxylic amines. • Give synthesis diazonium salt from amines and reactions of diazonium salt. • Perform inter conversion of functional groups
S.Y.B.Sc.	**CH-403: Practical Chemistry-IV**	• Verify theoretical principles experimentally • Interpret the experimental data on the basis of theoretical principles. • Correlate the theory to the experiments. Understand / verify theoretical principles by experiment or explain practical output with the help of theory. • Understand systematic methods of identification of substance by chemical methods. • Write balanced equation for all the chemical reactions performed in the laboratory. • Perform organic and inorganic synthesis and able to follow the progress of the chemical reaction.

		• Set up the apparatus properly for the designed experiments. • Perform the quantitative chemical analysis of substances and able to explain principles behind it.
Semester-III **Course: ()**		
T.Y.B.Sc.	**CH-331: Physical Chemistry**	**Chemical Kinetics** • After studying this topic students are expected to knowing. • Expression for rate constant k for third order reaction • Examples of third order reaction • Characteristics of third order rate constant k • Derivation for half-life period of third order reaction and to show that half-life is inversely proportional to square of initial concentration of reactants. • Experimental determination of order of reaction by Integrated rate equation method, Graphical method, Half-life method and Differential method. • Explain the term energy of activation with the help of energy diagram • Explain the term temperature coefficient. • Effect of temperature on rate constant k • Derivation of Arrhenius equation • Graphical evaluation of energy of activation • Solve the numerical problems based on this topic. **Electrolytic Conductance:** • After studying these topic students are expected to knowing. Ohm's law and electrical units such as coulomb, Ampere, Ohm and Volt. • Meaning of specific resistance, specific conductance, cell constant and their units. • Cell constant, its theoretical and experimental determination. • Preparation of conductivity water. • Experimental determination of conductance. • Variation of specific and equivalent conductance of strong and weak electrolyte with dilution • Meaning of infinitely dilute solution. • Kohlrausch's law of independent migration of ions and its applications such equivalent conductance of weak electrolyte at zero conc., degree of dissociation (α), ionic product of water. • Transport number of an ion • Hittorf's rule

		• Experimental determination of transport number by Hittorf's and moving boundary method. • Drawbacks of Arrhenius theory, Debye-Huckel-Onsager Interionic Attraction theory • Asymmetry /Relaxation effect • Electrophoresis effect • Validity of Onsager equation • Fugacity and activity concept • Activity and activity coefficient of strong electrolyte. • Solve the numerical problems based on this topic. **Investigation of molecular structure:** • After studying this topic students are expected to Known. Understand the term additive and constitutive properties • Understand the term specific volume, molar volume and molar refraction. • Understand the meaning of electrical polarization of molecule. • Understand the meaning of induced and orientation polarization • Dipole moment and its experimental determination by temperature variation method. • Application of dipole moment for structure determination. • Nature of wave and its characteristics such as wavelength, wave number, frequency and velocity. • Rotational / Microwave spectroscopy • Derivation for rotational spectra for the transition from J to J+1 • Limitations of Rotational Spectra. • Vibrational Spectra • Vibrational rotational Spectra • Raman Spectroscopy • Solve the numerical problems based on this topic. **Phase Rule:** • After studying this topic students are expected to knowing Meaning and Types of equilibrium such as true or static, metastable and Unstable Equilibrium. • Meaning of phase, component and degree of freedom. • Derivation of phase rule. • Explanation of water system: Description of the curve, Phase rule relationship and typical features. • Explanation of Sulphur system: Description of the

		curve, Phase rule relationship and Typical features. • vi. Explanation of two component system curve: for silver-lead and Zinc-cadmium.
T.Y.B.Sc.	**Inorganic Chemistry (CH-332)**	**Molecular orbital theory** • Know the theories of covalent bond formation • Know the assumptions and limitations of VBT • Understand the need of concept of MOT • Know LCAO principal and its approximation • Understand and show the formation of bonding and antibonding MO's • Draw the shapes of s, p, d orbital • Draw combinations of s-s, s-p, p-p and d-d orbital to form σ and π molecular orbitals. • Give the comparison of a) Atomic orbital and molecular orbital b) BMO and ABMOc) Sigma and pi MO'sd) VBT and MOT e) Comparison between BMO, ABMO and NBMO • Draw the MO energy level diagrams for homonuclear diatomic molecules having interactions between 2s and 2p orbitals and having no interactions between 2s and 2p orbitals: H2, H2+,He2+, Li2, Be2, B2, C2, N2, O2, O2+, O2-, O_2^{2-}, F2, Ne2, • Draw the shapes of molecular orbitals. • Give the calculations of bond order, energy and explanation on stability of the above molecule and ions • Draw the MO energy level diagrams for heteronuclear diatomic molecules: CO, NO, HCl, HF and calculations of bond order, energy and explain the stability of the molecules. • Understand the formation of BMO, ABMO and NBMO in CO2 or NO2 molecule and construct MO energy level diagrams for them. **Co-ordination Chemistry** Know the meaning of various terms involved in coordination chemistry. • Know the different types of Ligands. • Understand the chelating agents, chelate and stability of chelates and complexes. • Calculate the charge on complex ion and the oxidation number. • Be able to give the IUPAC name the co-ordination compound. • Know the application of co- ordination compounds in biology and chemistry. • Be able to understand the Werner's formulation of

		complexes and identify the ionizable ions. • Be able to distinguish between ionizable and non-ionizable valencies with suitable examples. • Give the suitable physical and chemical test for identification of number and types of ionizableions. • Be able to draw the geometrical and optical isomerism of complexes. • Choose the correct geometry for complexes with C.N. 4 and C.N. 6 with the help of stereoisomerism. • Be able to define and explain isomerism in complexes. • Be able to explain various types of isomerism. • Comment on the stereoisomerism in complexes with C.N. 4 and C. N. 6. • Define EAN rule and calculate EAN value of the complexes. • Comment on EAN value and stability of complexes. • Know the merits and the demerits of Sedgwick's theory. • Be able to explain the need of concept of hybridization. • Explain the VB representation of tetrahedral, square planar, trigonalbipyramidal and octahedral Complexes. • Be able to identify which d-orbitals are involved in hybridization during formation of complexes with different geometries such as tetrahedral, square planar, trigonalbipyramidal and octahedral. • Be able to explain structure and magnetic behavior of the complexes. • Be able to identify the high spin and low spin complexes. • Be able to identify inner orbital and outer orbital complexes. • Explain elctroneutrality principle and different types of pi bonding. • Know the limitations of VBT. • Know the shapes of d-orbitals and degeneracy of d-orbitals.
T.Y.B.Sc.	**Organic Chemistry (CH-333)**	• Definition and types of organic acid and base • The pka and pkb concepts • Effect of temperature on pka/pkb • Comparison between strengths of acids/base • What is acid-base catalysis • To draw different types of disubstituted

		cyclohexane in Chair form • To distinguish between geometrical and optical isomerism • Stability, energy calculations with potential energy diagram and optical activity of these conformers. • Definition and type of nucleophiles and leaving groups • Different types of nucleophilic substitution reactions • Definition of inversion and racemization • The kinetics, mechanism & stereochemistry of these reactions • Whether a given reaction follows SN1 or SN2 mechanism? • The comparison between SN1 & SN2 reactions • An SNi mechanism in presence and absence of pyridine • To predict product/s or supply the reagent/s for these reactions • Different types of carbon-carbon unsaturated compounds • Orientation / rules in addition reactions • The structure of carbonyl group • Reactivity concept • Correct mechanism of addition reactions using different reagents • Types of some known addition reactions • To predict product/s or supply the reagent/s for such reactions. • Definition and types of elimination reactions • Different types of bases and leaving groups • Statement of Hoffmann and Saytzeff rule • The evidences, mechanism & stereochemical aspects of these reactions • Whether a given reaction follows E1, E2 or E1cB mechanism? • Comparison between E1 & E2 reactions • The effect of structure, attacking and leaving group on reactivity of such reactions • To predict product/s or supply the reagent/s for these reactions
T.Y.B.Sc.	**Analytical Chemistry (CH-334)**	Student should know, • Principles of common ion effect and solubility product • Formation of complex ion • Factors affecting on solubility of precipitation • Phenomenon of super saturation and precipitation

		formation • Meaning of co-precipitation and post precipitation • Choice of liquid for washing the precipitate • Precautions during filtration, drying and ignition of precipitate • Conceptual understanding of electro gravimetric principle • Numerical Problems Methods of thermo gravimetric analysis • Principles of TGA and DTA • Types of TGA • Relation between TGA and DTA • Thermal equation of TGA • Different factors affecting TGA curve • Determination of calcium oxalate precursor • Applications of TGA, DTA and DSC • Principles of Spectrophotometric analysis and properties of electromagnetic radiations • Different Terms like absorbance, transmittance, and molar absorptivity • Mathematical Statement and derivation of Lambert's Law and Beer's Law • Different wavelength selectors and their importance • Instrumentation and working of single and double beam spectrophotometer • Additivity Principle • Different methods of color comparators Applications • Numerical Problems • Voltammetry and polarography as an analytical tool • Construction, working, advantages and disadvantages of DME • Different terms involved in Ilkovic equation • Determination of Zn and Cd from the mixture • Significance of the different terms involved. • Need of removal of dissolved oxygen from analyte solution • Applications and numerical problems • Atomic absorption spectroscopy as an analytical tool • Measurement of absorbance of atoms by AAS. • Interferences in atomic absorption spectroscopy • Applications and numerical problems • Emission spectroscopy as an analytical tool • Measurement of emission of atomic species

		• Different methods of analysis • Application and numerical problems.
T.Y.B.Sc.	**Industrial Chemistry (CH-335)**	**1. Modern Approach to Chemical Industry** The students are expected to learn; • Importance of chemical industry, • Meaning of the terms involved, • Comparison between batch and continuous process, • Knowledge of various industrial aspects **2. Agrochemicals** Students should know the • Various insecticides, • Pesticides, • Fungicides, • Rodenticides &biopesticides used in agriculture field with their synthesis and applications. **3. Manufacture of Basic Chemicals** Students should know the • Concept of basic chemicals, • Their uses and manufacturing process. • They should also know the physic chemicals principals involved in manufacturing process **4. Petrochemicals and eco-friendly fuels** • Introduction, occurrence, composition of petroleum, resources, processing of petroleum, other properties • Fuels and eco-friendly fuels, use of solar energy etc. **5. Food and Starch Industry** • **Food Industry:** • Students should know • Scope, • Nutritive aspects of food constituents, • Quality factors and their measurements, • Food deterioration factors and their control; • Food preservation and Food additives **Starch Industry**: Students should know about the • Chemistry of starch, • Manufacturing of industrial starch and its applications, • Characteristics of some food starches, • Non-starch polysaccharides-cellulose-occurrence **6. Cement and Glass industry** • **Cement industry** The students are expected to

		• Learn importance of these industries, • Manufacture of cement by modern methods • Definition of setting and hardening • Reinforced concrete **Glass industry** • The students are expected • To learn about making of glass by different methods, • Various operations involved in the manufacture and compositions, • Properties and uses of special glasses.
T.Y.B.Sc.	**CH-346D Environmental and Green Chemistry**	Students should know. • Importance and conservation of environment. Knowing Segments of atmosphere • Hazards of flue gases • Ozone depletion • Ecological changes due to hazardous gases • Understand the social issues • Water resources • Quality of potable water • WHO limits for toxic materials in water stream • Quality measures • Need of green chemistry technology • Principles of green chemistry • Advantages of green chemistry • Simple examples to clarify the principles • Catalytic routes for sustainable developments